

# **PROGRAM ANNOUNCEMENT TO NATIONAL LABORATORIES FOR SUBMISSION OF APPLICATIONS FOR RESEARCH AND DEVELOPMENT PROJECTS**

## **OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY**



### **Laboratory Call for Research and Development for On-Board Vehicular Hydrogen Storage**

**DE-PS36-06GO96012P**

**Announcement Type: Modification**

**Issuing Office:** U.S. Department of Energy  
Golden Field Office  
Hydrogen, Fuel Cells and Infrastructure  
Technologies Program

**Issue Date:** 03/27/2006

**Preliminary Applications Due Date:** 06/07/2006 at 11:59 PM Eastern Time

**Invitations for Final Applications Sent:** 08/04/2006

**Final Applications Due Date:** 09/29/2006 at 11:59 PM Eastern Time

**Point of Contact:** Genevieve Wozniak  
**Phone:** (303) 275-4942  
**Electronic Mail:** H2Storage@go.doe.gov

DATE: May 11, 2006

FROM: James P. Damm, Contracting Officer

TO: All Prospective Applicants

SUBJECT: Amendment No. 002 to Announcement No. DE-PS36-06GO96012P, Lab Call for Research and Development for On-Board Vehicular Hydrogen Storage

The Announcement is amended as follows:

The purpose of this Amendment 002 is to clarify DOE's intent to allow applicants to apply for both Category 1 and Category 2 with the same application. The original language in the Announcement neither specifically allows nor prohibits applicants from applying to both categories simultaneously for the same project.

The requirements for applicants applying to both Category 1 and Category 2 with the same application are as follows: 1) the application must meet the requirements for both categories; and 2) the cover page of the application must clearly state the applicant's intent to apply for both categories and clearly state the applicable technical topic of the application.

In addition, this amendment clarifies that all applications will be evaluated using the same criteria, regardless of the category designation. The potential for an applicant to become a partner in a Center of Excellence will be considered by DOE only after selections are made and will have no affect on the evaluation and selection process.

The text in the original Announcement that has been added, pursuant to this Amendment 002, is highlighted in yellow in the attached revised Announcement document.

All other parts of the Announcement remain unchanged.

## TABLE OF CONTENTS

I.	SUMMARY .....	1
A.	Eligible Applicants .....	1
B.	Cost Share .....	2
C.	Applications .....	2
D.	Application Submittal Address.....	2
E.	Application Due Dates and Times .....	3
F.	For Further Information or Questions and Answers Contact .....	4
II.	SUPPLEMENTARY INFORMATION.....	5
A.	Introduction .....	5
B.	Background .....	5
C.	Scope .....	6
D.	Budget.....	8
E.	Anticipated Award Size .....	8
III.	APPLICATION PREPARATION INSTRUCTIONS.....	9
A.	Preliminary Applications .....	9
B.	Final Applications .....	11
C.	Proprietary Application Information.....	16
IV.	APPLICATION REVIEW INFORMATION .....	18
A.	Criteria .....	18
B.	Review and Selection Process .....	20
C.	Anticipated Notice of Selection and Award Dates .....	21
V.	GENERAL CONDITIONS .....	22
A.	Partial Awards .....	22
B.	Debarred and Suspended Parties .....	22
C.	National Environmental Policy Act (NEPA) Requirements .....	22
D.	Reporting.....	22
E.	Intellectual Property Developed Under This Program.....	22
F.	Data Protection Statute .....	23

APPENDIX A – DEFINITIONS

APPENDIX B – INDUSTRY INTERACTIVE PROCUREMENT SYSTEM (IIPS) 3.5

APPENDIX C – TECHNOLOGY TOPICS

**AGENCY:** Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE)

**ACTION:** FY2006 Program Announcement: Laboratory Call for Research and Development for On-Board Vehicular Hydrogen Storage

## I. SUMMARY

The Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) is soliciting applications from National Laboratories with the objective of supporting the President's Hydrogen Fuel Initiative in developing a pathway to a hydrogen economy. To support this initiative, this DOE Hydrogen Program Announcement seeks to fund the research and development of viable hydrogen storage technologies for on-board vehicular applications.

The original "Grand Challenge" solicitation launched in 2003 was planned for approximately \$150 million over 5 years, subject to appropriations, and forms the basis for the bulk of DOE's current hydrogen storage activity. Including new awards in basic research by the DOE Office of Science, announced in 2005, the DOE "National Hydrogen Storage Project" includes roughly 40 universities, 15 companies and 10 federal laboratories. **This Program Announcement is for approximately 3 to 6 new projects to be selected to complement the "Grand Challenge" activities.**

A separate Funding Opportunity Announcement (DE-PS36-06GO96003), titled "Research and Development for On-Board Vehicular Hydrogen Storage," offers opportunities for institutions of higher education, nonprofit or for profit private entities, and state and local governments to submit applications as primary applicants. The two announcements are parallel to each other and projects will be evaluated and selected using the same criteria. The total funding ceiling for all new awards selected from both announcements will be \$6,000,000, with no predetermined division of funding between the two announcements. Proposals selected under this Lab Call will be funded directly through the laboratory contract and will be subject to the terms and conditions of the laboratory contract.

### A. Eligible Applicants

The primary applicant submitting applications for this Program Announcement must be a National Laboratory as defined by Section 2 of the Energy Policy Act of 2005. National Laboratories (Labs) include: Ames Laboratory; Argonne National Laboratory; Brookhaven National Laboratory; Fermi National Accelerator Laboratory; Idaho National Laboratory; Lawrence Berkeley National Laboratory; Lawrence Livermore National Laboratory; Los Alamos National Laboratory; National Energy Technology Laboratory; National Renewable Energy Laboratory; Oak Ridge National Laboratory; Pacific Northwest National Laboratory; Princeton Plasma Physics Laboratory; Sandia National Laboratory; Savannah River National Laboratory; Stanford Linear Accelerator Center; and Thomas Jefferson National Accelerator Facility. The National Lab may team with industry, academic organizations and/or other Federal labs as appropriate, but teaming is not required. It is the burden of the primary applicant to obtain the appropriate approval to conduct the proposed work for this EERE program announcement if the applicant is part of the National Nuclear Security Administration (NNSA).

Foreign participants will not be eligible as the prime applicant. However, foreign participants will be allowed as laboratory subcontractors to a domestic applicant provided that:

- The foreign subcontractor effort, in aggregate, shall not exceed 20% of the total estimated cost of the project, including the applicant's and the foreign subcontractor's portions of the effort.
- The technical approach is unique and is not duplicative of any work that DOE is currently funding.
- The technology developed must be made available in the United States.
- The foreign participant must provide at least 20% cost sharing for their own portion of the project.

## **B. Cost Share**

This Program Announcement does not require cost share by National Labs. However, cost share will be required for institutions of higher education, nonprofit or for-profit private entities, and state and local governments who team with the National Lab primary applicant. The non-National Lab portion of the budget will require a 20% minimum cost share for applied research and/or development from non-federal sources. Federally-funded laboratories that partner with the primary National Lab applicant, who are not included in the list of National labs under Section 2 of the Energy Policy Act of 2005, are also not required to cost share.

## **C. Applications**

Applications are to be prepared for the complete project period. An applicant may apply for Category 1, Category 2, or both categories with the same application, as described in Section II.C below. For either category (or both), applicants may not submit an application that covers more than one technical topic, (i.e., separate applications must be submitted for separate technical topics).

See Section III of this Program Announcement below for application preparation instructions, and Section IV for Evaluation Criteria and procedures. Section V identifies additional general requirements that are also applicable.

## **D. Application Submittal Address**

Applications must be submitted through the DOE Industry Interactive Procurement System (IIPS) at <http://e-center.doe.gov>. Instructions on how to submit an application or an application amendment and how to register, submit questions, and view questions and answers are located in Appendix B and on the web site at <http://e-center.doe.gov>: click on the Help button.

Prepare all required files in accordance with the instructions in this announcement prior to starting the transmission process. Submit the entire application package in one IIPS session (i.e., do not logoff before all the files are submitted).

When you are ready to submit your application, go to <http://e-center.doe.gov> and complete the IIPS cover page. Enter the project title and the name of the principal investigator/project director, in the "Subject" block. Then attach each file in the corresponding block in accordance with the IIPS guidance. Follow the instructions for submitting the application.

If you have any problems accessing information or submitting your application, contact the Help Desk at 1-800-683-0751 and select option 1, or send an email to HelpDesk@pr.doe.gov.

ONLY APPLICATIONS SUBMITTED THROUGH IIPS WILL BE CONSIDERED FOR AWARD.

Applications submitted through IIPS constitute submission of electronically signed applications. The name of the authorized organizational representative (i.e., the administrative official, who, on behalf of the proposing organization, is authorized to make certifications and assurances or to commit the applicant to the conduct of a project) must be typed in the signature block on the form to be accepted as an electronic signature. Do not submit a scanned copy of the signed document.

In order to submit an application, you must be authorized by the applicant (i.e., institution or business entity) to submit an application on its behalf and you must register in IIPS. You are encouraged to register as soon as possible. You only have to register once to apply for any DOE award.

To register go to <http://e-center.doe.gov> and follow the registration instructions.

Amendments to this announcement will be posted on the DOE Industry Interactive Procurement System (IIPS).

If you register in IIPS, you may join this announcement mailing list to receive an email when an amendment or an announcement message is posted. To view amendments and announcement messages, locate the announcement on IIPS and click on the folder next to the announcement number or follow the directions for "Locate Solicitation."

#### **E. Application Due Dates and Times**

The application process will include two phases -- a preliminary application phase and a final application phase. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.

Preliminary applications must be received by **June 7, 2006**, no later than **11:59 PM Eastern Time**. You are encouraged to transmit your application well before the deadline. APPLICATIONS, INCLUDING ALL APPLICATION FILES, RECEIVED AFTER THE DEADLINE, AS DEMONSTRATED BY THE IIPS DATE/TIME STAMP, WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.

Successful preliminary applications will receive invitations to submit a final application. These letters will be sent by **August 4, 2006**.

The Final applications must be received by **September 29, 2006**, no later than **11:59 PM Eastern Time**. You are encouraged to transmit your application well before the deadline. APPLICATIONS, INCLUDING ALL APPLICATION FILES, RECEIVED AFTER THE DEADLINE, AS DEMONSTRATED BY THE IIPS DATE/TIME STAMP, WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.

**F. For Further Information or Questions and Answers Contact**

Questions regarding the content of the announcement must be submitted through the “Submit Question” feature of the DOE Industry Interactive Procurement System (IIPS) at <http://e-center.doe.gov>. Locate the announcement on IIPS and then click on the “Submit Question” button. Enter the required information. You will receive an electronic notification that your question has been answered. DOE will respond to a question within 5 business days, unless a similar question and answer have already been posted on the website.

Responses to questions may be viewed through the “View Questions” feature (button at the top of the page). If no questions have been answered, a statement to that effect will appear. You should periodically check “View Questions” for new questions and answers.

Questions regarding how to submit questions or to view responses can be e-mailed to the IIPS HELP Desk at [helpdesk@pr.doe.gov](mailto:helpdesk@pr.doe.gov) or by calling 1 (800) 683-0751. Questions must be submitted no later than 5 business days prior to the closing date.

## II. SUPPLEMENTARY INFORMATION

### A. Introduction

The Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) is soliciting applications from National Laboratories with the objective of supporting the President's Hydrogen Fuel Initiative in developing a pathway to a hydrogen economy. To support this initiative, this DOE Hydrogen Program Announcement seeks to fund the research and development of viable hydrogen storage technologies for on-board vehicular applications. DOE intends to provide financial support for this effort under authority of the Energy Policy Act of 2005, Public Law 109-58, in particular the Spark M. Matsunaga Hydrogen Act of 2005, Title VIII – Hydrogen.

In his January 2003 State of the Union Address, President Bush announced the Hydrogen Fuel Initiative – “so that America can lead the world in developing clean, hydrogen-powered automobiles.” Hydrogen storage technology – the ability to carry enough hydrogen on-board a vehicle to enable a greater than 300-mile vehicle range – is crucial to the success of the President's Initiative. At the present time, no existing hydrogen storage technology meets the challenging performance required to make hydrogen-powered automobiles competitive with traditional vehicles. New and innovative ideas are needed on a continuing basis and this is the motivation for this announcement. Projects funded through this announcement will be incorporated into the framework of The National Hydrogen Storage Project, which was initiated in April 2004.

### B. Background

For transportation, the overarching technical challenge for hydrogen storage is how to store the amount of hydrogen required for a conventional driving range (greater than 300 miles), within the vehicular constraints of weight, volume, efficiency, safety, and cost. Durability over the performance lifetime of these systems must also be verified and validated and acceptable refueling times and hydrogen delivery flow rates must be achieved.

The goal of the DOE hydrogen storage activity is to fund the research and development of viable hydrogen storage technologies primarily for on-board vehicular applications. The major objectives for on-board vehicular hydrogen storage are:

- By 2010, develop and verify on-board hydrogen storage systems achieving 2 kWh/kg (6 wt.%), 1.5 kWh/Liter, and \$4/kWh.
- By 2015, develop and verify on-board hydrogen storage systems achieving 3 kWh/kg (9 wt.%), 2.7 kWh/Liter, and \$2/kWh.

See Table 1 in Appendix C for a complete list of the technical performance targets for on-board hydrogen storage systems. The technical targets for on-board hydrogen storage systems<sup>1</sup> were established through the FreedomCAR partnership between DOE and the

---

<sup>1</sup> See the following websites for details on the targets:  
[http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/freedomcar\\_targets\\_explanations.pdf](http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/freedomcar_targets_explanations.pdf) and



U.S. Council of Automotive Research (USCAR). The partnership was recently expanded to include the major energy companies and renamed the FreedomCAR and Fuel Partnership<sup>2</sup>. The key technical challenges are also described in Appendix C.

DOE has conducted a series of workshops to identify R&D needs and to assess priorities and strategies for on-board hydrogen storage. Based on the findings from these workshops, the DOE issued a “Grand Challenge” to the global scientific community for research in hydrogen storage in July 2003. This Grand Challenge called for the establishment of hydrogen storage Centers of Excellence in Metal Hydrides, Chemical Hydrogen Storage and Carbon-Based Materials, with multiple university, industry and federal laboratory partners. In addition, independent projects were solicited on new materials and concepts, off-board hydrogen storage systems, and analyses of life cycle cost, performance and environmental impact. Complementing the Grand Challenge, the DOE Office of Science issued a solicitation in 2004 for basic research to help overcome key hurdles in hydrogen production, storage and conversion. The new Centers of Excellence and independent projects, together with existing DOE hydrogen storage efforts constitute the framework for the National Hydrogen Storage Project.

The original “Grand Challenge” solicitation launched in 2003 was planned for approximately \$150 million over 5 years, subject to appropriations, and forms the basis for the bulk of DOE’s current hydrogen storage activity. Including new awards in basic research from the DOE Office of Science, announced in 2005, the DOE “National Hydrogen Storage Project” includes roughly 40 universities, 15 companies and 10 federal laboratories. **This Program Announcement is for approximately 3 to 6 new projects to be selected to complement the “Grand Challenge” activities.**

### C. Scope

The goal of the DOE hydrogen storage activity is to fund the research and development of viable hydrogen storage technologies primarily for on-board vehicular applications. Applications are requested in the following two categories:

**Category 1:** Projects are sought that are supportive of and complementary to the activities of any of the existing Hydrogen Storage Centers of Excellence in Metal Hydrides, Chemical Hydrogen Storage, and Carbon-Based Materials. Such projects must help establish important new technical approaches or capabilities not presently available at the Centers. A successful applicant may become a Center partner, provided that the applicant signs an existing non-disclosure agreement that has been signed by each of the existing Center partners. **The appropriate Center must be clearly stated on the cover page of the application. If the work is applicable to more than one Center, then each applicable Center should be listed on the cover page.**

---

[www.eere.energy.gov/hydrogenandfuelcells/mypp](http://www.eere.energy.gov/hydrogenandfuelcells/mypp)

<sup>2</sup> The FreedomCAR and Fuel Partnership includes U.S. Department of Energy, USCAR (DaimlerChrysler Corporation, Ford Motor Company and General Motors Corporation), BP America, ChevronTexaco, ConocoPhillips, ExxonMobil Corporation and Shell Hydrogen U.S.

Category 1 applicants are encouraged to research the ongoing Center work at:  
[http://www.nrel.gov/basic\\_sciences/carbon\\_based\\_hydrogen\\_center.cfm](http://www.nrel.gov/basic_sciences/carbon_based_hydrogen_center.cfm);  
<http://www.ca.sandia.gov/MHCoE/>;  
<http://www.chscpublic.ua.edu/>;  
<http://www.eere.energy.gov/hydrogenandfuelcells/storage>;  
[http://www.hydrogen.energy.gov/annual\\_progress05.html](http://www.hydrogen.energy.gov/annual_progress05.html);  
[http://www.hydrogen.energy.gov/annual\\_progress04.html](http://www.hydrogen.energy.gov/annual_progress04.html);  
[http://www.hydrogen.energy.gov/annual\\_review05\\_report.html](http://www.hydrogen.energy.gov/annual_review05_report.html); and  
<http://www.eere.energy.gov/hydrogenandfuelcells>

**Category 2:** Applications are sought for independent research and development projects that address one of three technical topics: 1) Materials Discovery; 2) Engineering Science; or 3) Systems, Safety and Environmental Analyses. These three topics, as well as required cost share and technical objectives, are described in Appendix C. Research and development of cylindrical high pressure or liquid on-board storage tanks and off-board storage are not sought under this announcement and will not be reviewed. The appropriate topic must be clearly stated on the cover page of the application.

Appendix C discusses the technology topics for both Categories 1 and 2. The topics in Appendix C are the only eligible research areas under this announcement.

Applicants seeking to become a partner in a Center of Excellence should apply to Category 1. The appropriate Center should be clearly stated on the cover page of the application. If the work is applicable to more than one Center, then each applicable Center should be listed on the cover page.

Applicants not seeking to become a partner in a Center of Excellence should apply only to Category 2. The appropriate technical topic should be clearly stated on the cover page of the application.

Applicants may apply for both Category 1 and Category 2 with the same application, provided that the application meets the technical topic requirements for both categories as described in Appendix C. However, applicants should not submit separate applications for the same project under both categories. Applicants wishing to apply to both categories with the same application must state both the appropriate Category 1 Center of Excellence and the appropriate Category 2 technical topic on the cover page of their application. Category 1 applications will not be considered for an award under Category 2 unless the application clearly states the applicant's intention to apply for both categories with the same application.

For either category (or both), applicants may not submit an application that covers more than one technical topic, (i.e., separate applications must be submitted for separate technical topics).

It is intended that this announcement will be issued on an annual basis, subject to congressional appropriations and direction. New projects will be selected each fiscal year based on technical merit review, program policy review and the availability of funds. Projects will typically be of 2 to 5-year duration. The overall project duration will be subdivided into two or more phases with overall project go/no-go decision points between the phases.

The application process will include two phases -- a preliminary application phase and a final application phase. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.

Applicants receiving an award under this announcement will be required to provide periodic reports and presentations to DOE. Refer to Section V.D for further information.

#### **D. Budget**

A separate Funding Opportunity Announcement (DE-PS36-06GO96003), titled "Research and Development for On-Board Vehicular Hydrogen Storage," offers opportunities for institutions of higher education, nonprofit or for profit private entities, and state and local governments to submit applications as primary applicants. The two announcements are parallel to each other and projects will be evaluated and selected using the same criteria. The total funding ceiling for all new awards selected from both announcements will be \$6,000,000, with no predetermined division of funding between the two announcements. Proposals selected under this Lab Call will be funded directly through the laboratory contract and will be subject to the terms and conditions of the laboratory contract.

Approximately \$1,000,000 to \$2,000,000 is expected to be available each fiscal year beginning in FY2007 for new awards under these parallel announcements. Approximately \$3,000,000 to \$6,000,000 in total is expected to be available for new awards under these announcements over the 2 to 5 year lifetime of the awards. The actual level of funding, if any, depends on the appropriations for this program.

#### **E. Anticipated Award Size**

DOE expects to fund each award at \$400,000 to \$2,000,000 over 2 to 5 years. If requested levels are higher, applicants must justify need for more funds. The awards will be incrementally funded each year, where the amounts available each fiscal year will vary depending on the funds available, number of awards, technical merit review and program policy review.

### III. APPLICATION PREPARATION INSTRUCTIONS

#### A. Preliminary Applications

You must complete the mandatory forms in accordance with the instructions on the forms and the additional instructions below.

##### 1. Field Work Proposal File

Applicants must complete a DOE Field Work Proposal in accordance with the requirements in DOE Order 412.1 Work Authorization System. This order and the DOE Field Work Proposal form are available at <http://grants.pr.doe.gov>. Save this form in a file named "FWP."

##### 2. Project Narrative File

This section should provide a clear description of the work to be undertaken and how you plan to accomplish it. It must be formatted to address each of the preliminary merit review criteria and sub-criteria listed in Section IV.A.2. Provide sufficient information so that the reviewers will be able to evaluate the application in accordance with these merit review criteria. Do not include any Internet addresses (URLs) that provide information necessary to review the application. See Section III.C for instructions on how to mark proprietary information in the application.

The project Narrative file must be formatted to separately address each of the sections listed below. Each section must not exceed the specified page limitation when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point.

The Project Narrative section must not exceed 7 pages, as prescribed below. Graphics and visual material, including charts, graphs, maps, photographs, and other pictorial presentations, must be included in the Narrative document and will be counted in the page limitation for this section. **NOTE: Any pages that exceed the specified maximum number of pages for any item will be removed and will not be considered during the evaluation.** Evaluators will review only the number of pages specified.

Save all the Project Narrative information in a single file named "Project Narrative."

The Narrative shall consist of the following sections, with page limits where indicated:

##### a) Cover Page (one-page limit)

The Narrative cover page must indicate the name of the organization, the announcement number, the project title, and both the technical and business points of contact for the applicant, denoting the names, titles, addresses, telephone and facsimile numbers, and electronic mail addresses. The cover page should also identify the name and type of organization for key participants, along with names, titles, addresses, telephone and facsimile numbers, and electronic mail addresses of participant contacts. **The category and technical topic must also be clearly stated on the cover page. Category 1 applicants should indicate which Center of Excellence**

they wish to join. If the work is applicable to more than one Center, then each applicable Center should be listed on the cover page. Category 2 applicants should indicate the specific technical topic from Appendix C. Applicants wishing to apply for both categories with the same application should indicate all of the above information on the cover page. Please note however that for either category (or both), applicants may not submit an application that covers more than one technical topic, (i.e., separate applications must be submitted for separate technical topics).

b) Technical Summary (one-page limit)

A one-page technical summary shall be included in the Narrative to describe the proposed project in technical terms and explain how the proposed project will work toward the achievement of the targets and objectives in Appendix C. The name of the applicant and title of the proposed project shall be indicated at the top of the summary page.

c) Technical Proposal (5-page limit)

The Technical Proposal portion of the Narrative for the preliminary application shall be structured in accordance with the sections indicated below. The applicant should specify the technical challenges being addressed and must address the items listed below.

**Section I: Technical Concept and Impact**

- Describe the overall relevance and applicability of the technical concept and approach in addressing the technical challenges facing on-board hydrogen storage
- Address and quantify the degree to which the project will advance hydrogen storage technology for on-board vehicular applications toward the program's specific technical performance targets
- Describe the innovation of the proposed technology or methodology compared to previous and on-going work by others

**Section II: Work Plan**

- Describe the work plan, including a schedule, milestones and go/no-go decision points with the go/no-go decision criteria for the proposed project
- Address the experience of the Principal Investigator and the project team in performing research in this discipline or related areas; provide a brief description of the relevant facility capabilities

Applicants must review Section IV.A.2, "Evaluation Criteria for Preliminary Applications," to be certain that all aspects of the evaluation criteria are adequately covered in the Technical Proposal.

To avoid duplication of current DOE-sponsored research in the relevant topic areas, the following information regarding current projects has been made available:

- The DOE Hydrogen Storage Program at <http://www.eere.energy.gov/hydrogenandfuelcells/storage;>

- The DOE Hydrogen Program Annual Progress Reports at [http://www.hydrogen.energy.gov/annual\\_progress05.html](http://www.hydrogen.energy.gov/annual_progress05.html) and [http://www.hydrogen.energy.gov/annual\\_progress04.html](http://www.hydrogen.energy.gov/annual_progress04.html);
- The DOE Hydrogen Program Annual Merit Review and Peer Evaluation Report at [http://www.hydrogen.energy.gov/annual\\_review05\\_report.html](http://www.hydrogen.energy.gov/annual_review05_report.html); and
- Target explanations at [http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/freedomcar\\_targets\\_explanations.pdf](http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/freedomcar_targets_explanations.pdf) and <http://www.eere.energy.gov/hydrogenandfuelcells/mypp/>

Category 1 applicants are encouraged to research the ongoing Center work at [http://www.nrel.gov/basic\\_sciences/carbon\\_based\\_hydrogen\\_center.cfm](http://www.nrel.gov/basic_sciences/carbon_based_hydrogen_center.cfm); <http://www.ca.sandia.gov/MHCoE/>; and <http://www.chscpublic.ua.edu>

### 3. Authorization for DOE National Labs

The cognizant contracting officer must authorize in writing the use of a DOE National Laboratory contractor on the proposed project and this authorization must be submitted with the application. The following language is acceptable for this authorization.

“Authorization is granted for the \_\_\_\_\_ Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory and will not adversely impact execution of the DOE assigned programs at the laboratory.”

Save the authorization in a file named “Authorization Statement.”

### 4. Summary of Required Attachments for Preliminary Application Phase

In summary, the applicant must submit the following attachments in IIPS:

IIPS Designation	Attach the Following Documents	File Name
Application	Field Work Proposal	FWP
Project Narrative	Project Narrative	Project Narrative
Attachment 1	Authorization for DOE National Labs	Authorization Statement

## B. Final Applications

Applicants that have been invited to submit a final application must complete the mandatory forms in accordance with the instructions on the forms and the additional instructions below.

### 1. Field Work Proposal File

Applicants must complete a DOE Field Work Proposal in accordance with the requirements in DOE Order 412.1 Work Authorization System. This order and the DOE Field Work Proposal form are available at <http://grants.pr.doe.gov>. Save this form in a file named “FWP.”

## 2. Public Abstract File

The public abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as the Department may make it available to the public. The public abstract must not exceed 1 page when printed using standard 8.5" by 11" paper with 1" margins (top, bottom, left and right) with font not smaller than 11 point. Save this information in a file named "Public Abstract."

## 3. Project Narrative File

This section should provide a clear description of the work to be undertaken and how you plan to accomplish it. It must be formatted to address each of the final merit review criteria and sub-criteria listed in Section IV.A.2. Provide sufficient information so that the reviewers will be able to evaluate the application in accordance with these merit review criteria. Do not include any Internet addresses (URLs) that provide information necessary to review the application. See Section III.C for instructions on how to mark proprietary information in the application.

The Project Narrative file must be formatted to separately address each of the sections listed below. Each section must not exceed the specified page limitation, if any, when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point.

The Project Narrative must not exceed the page limits where indicated in the descriptions below. **NOTE: Any pages that exceed the specified maximum number of pages below for any item will be removed and will not be considered during the evaluation.** Evaluators will review only the number of pages specified.

Save all the Project Narrative information in a single file named "Project Narrative," except for letters of commitment and personnel resumes as noted below.

The Narrative shall consist of the following sections, with page limits where indicated in the descriptions below.

### a) Cover Page (one-page limit)

The Narrative cover page must indicate the name of the organization, the announcement number, the project title, and both the technical and business points of contact for the applicant, denoting the names, titles, addresses, telephone and facsimile numbers, and electronic mail addresses. The cover page should also identify the name and type of organization for key participants, along with names, titles, addresses, telephone and facsimile, and electronic mail addresses of participant contacts. The category and technical topic must also be clearly stated on the cover page. Category 1 applicants should indicate which Center of Excellence they wish to join. Category 2 applicants should indicate the specific technical topic



from Appendix C. Applicants wishing to apply for both categories with the same application should indicate all of the above information on the cover page.

b) Table of Contents (no page limit)

The Narrative shall include a Table of Contents and page numbers corresponding to the elements outlined herein. The Table of Contents does not have a page limit.

c) Technical Summary (one-page limit)

A one-page technical summary shall be included in the Narrative to describe the proposed project in technical terms and to explain how the proposed project will work toward the achievement of the targets and objectives in Appendix C. The summary may contain information that is not releasable to the public. It is intended for use by technical evaluators. Please note that this summary is different than the Public Abstract File described above as the previous attachment, which should not contain any proprietary information. The name of the applicant and title of the proposed project shall be indicated at the top of the summary page.

d) Technical Proposal (10-page limit)

The technical proposal portion of the Narrative shall be structured in accordance with the following sections (the structure, order of contents, etc. within a section are at the discretion of the applicant). Graphics and visual material, including charts, graphs, maps, photographs, and other pictorial presentations, must be included in the Technical Proposal section and will be counted in the page limitation for this section. Lists of references for the document will not count against the page limit.

**Section I: Technical Concept**

- In the project overview, describe the goals, objectives, and how the proposed concept offers advantages over current emerging technologies and methodologies
- Describe the proposed technical concept and the research program that will investigate that technical concept
- Identify the key technical risk areas of the proposed concept and how they will be addressed
- Describe and quantify the potential of the proposed concept to advance the technology and to achieve DOE's specific technical performance targets for on-board storage systems

**Section II: Work Plan**

**Statement of Objectives**

- Define the goals and objectives of the project
- Describe how the proposed work plan will successfully meet the project goals
- Describe the work breakdown structure, including task descriptions



- Describe major milestones and the timing of these major milestones
- Describe the technical and administrative deliverables that will be produced throughout the project, including the specific end result of each phase
- Describe overall project go/no-go decision points (e.g. achieving x wt% hydrogen storage material capacity) and timing of these go/no-go decisions, as well as the quantitative criteria for how these go/no-go decisions will be made

#### **Project Management**

- Describe how the proposed project organization will facilitate project success
- Define the roles of the team members
- Describe the approach to managing the team and ensuring communication among team members
- Describe how project safety will be addressed, particularly handling of hydrogen and handling of potentially hazardous materials

### **Section III: Qualifications and Facilities**

#### **Personnel and Organization Qualifications**

- Describe the education, professional training, technical skills, and work experience of the Principal Investigator (PI) and other key personnel, including personnel from major subcontractors
- Describe the level of time commitment of the PI and other key personnel, including personnel from major subcontractors, assigned to the proposed project
- Address the capability of the proposed team to address all aspects of the proposed work
- Describe the relevant experience of each organization on the proposed team in performing similar projects

#### **Facilities**

- Describe the applicant's existing facilities, and those of subcontractors, proposed for completing the work
- Describe any request for new facilities or equipment

#### **e) Resources by Task (5-page limit)**

The Narrative shall include a summary of resources by Statement of Objectives task. The summary must include the following for the applicant and each participant:

- The job title and estimated number of hours for each of the key personnel proposed by task

- The estimated travel budget by task; the travel budget should include costs for up to two investigators for travel to Washington, D.C. twice per year for project reviews
- The total proposed equipment, materials, and supplies budget by task

Applicants must also review Section IV.A.2, "Evaluation Criteria for Final Applications," to be certain that all aspects of the evaluation criteria are adequately covered in the Technical Proposal.

#### **4. SF 424 A Excel, Budget Information – Non-Construction Programs File**

You must provide a separate budget for each year of support requested and a cumulative budget for the total project period. Use the SF-424A Excel, "Budget Information – Non Construction Programs" form on the Applicant and Recipient Page at <http://grants.pr.doe.gov>. You may request funds under any of the Object Class Categories as long as the item and amount are necessary to perform the proposed work and meet all the criteria for allowability under the applicable Federal cost principles. Save the information in a single file named "SF-424A."

#### **5. Commitment Letters from Third Parties Contributing to Cost Sharing File**

If a third party, (i.e., a party other than the organization submitting the application) proposes to provide all or part of the required cost sharing, the applicant must include a letter from the third party stating that it is committed to providing a specific minimum dollar amount of cost sharing. The letter should also identify the proposed cost sharing (e.g., cash, services, and/or property) to be contributed. Letters must be signed by the person authorized to commit the expenditure of funds by the entity. This file should be included as an attachment file rather than with the narrative file (these letters will not count against the page limit). Save this information in a single file named "Letters."

#### **6. Personnel Resumes**

The application should include resumes for key personnel of the applicant and major participants. This file should be included as an attachment file rather than with the narrative file (these resumes will not count against the page limit). Save this information in a single file named "Resumes."

## 7. Summary of Required Attachments for Final Application Phase

In summary, the applicant must submit the following attachments in IIPS:

IIPS Designation	Attach the Following Documents	File Name
Application	Field Work Proposal	FWP
Project Summary	Public Abstract	Public Abstract
Project Narrative	Project Narrative	Project Narrative
Budget Form	Form SF-424A	SF-424A
Attachment 1	Letters of Commitment	Letters
Attachment 2	Personnel Resumes	Resumes

### C. Proprietary Application Information

It should be noted that proposal information and data submitted directly from a National Laboratory cannot be considered proprietary; although, information and data submitted by a non-laboratory third party partner(s) may be considered proprietary.

Applications submitted in response to this Program Announcement may contain trade secrets and/or privileged or confidential commercial or financial information which the applicant and/or industrial partners do not want to be used or disclosed for any purpose other than evaluation of the application. The use and disclosure of such data may be restricted, provided the applicant marks the cover sheet of the application with the following legend, specifying the pages of the application which are to be restricted in accordance with the conditions of the legend:

“The data contained in pages \_\_\_\_\_ of this application have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes, provided that if this applicant receives an award as a result of or in connection with the submission of this application, DOE shall have the right to use or disclose the data herein to the extent provided in the award. This restriction does not limit the Government’s right to use or disclose data obtained without restriction from any source, including the applicant.”

Further, to protect such data, each page containing such data shall be specifically identified and marked, including each line or paragraph containing the data to be protected with a legend similar to the following:

“Use or disclosure of the data set forth above is subject to the restriction on the cover page of this application.”

It should be noted, however, that data bearing the aforementioned legend may be subject to release under the provisions of the Freedom of Information Act (FOIA), if DOE or a court determines that the material so marked is not actually proprietary and, thus, not exempt under the FOIA. The Government assumes no liability for disclosure or use of unmarked data and may use such data for any purpose.

Applicants are hereby notified that DOE intends to make all applications submitted available to non-Government personnel for the sole purpose of assisting DOE in its evaluation of the applications. These individuals will be required to protect the confidentiality of any specifically identified proprietary information obtained as a result of their participation in the evaluation.

## IV. APPLICATION REVIEW INFORMATION

### A. Criteria

#### 1. Initial Review Criteria

Prior to a comprehensive evaluation, an initial review of the applications will be performed by the DOE Golden Field Office (GO) to determine the following: 1) the applicant is eligible for an award; 2) the information required by the announcement has been submitted; and 3) the minimum required cost share for the particular technical topic has been proposed, if applicable. If an application fails to meet these requirements, it may be deemed non-responsive and eliminated from further review.

#### 2. Merit Review Criteria

##### **EVALUATION CRITERIA FOR PRELIMINARY APPLICATIONS**

The following evaluation criteria will be used in the comprehensive evaluation of preliminary applications. For each criterion, the weighting (out of a total of 100%) is indicated to show the relative importance.

##### **a) Technical Concept and Impact (Weight: 70%)**

- The overall relevance and applicability of the technical concept and approach in addressing the technical challenges facing on-board hydrogen storage
- The quantitative degree to which the project will advance hydrogen storage technology for on-board vehicular applications toward the program's technical performance targets
- The innovation of the proposed technology or methodology compared to similar previous and on-going work by others

##### **b) Work Plan (Weight: 30%)**

- Appropriateness of the work plan, schedule, milestones, go/no-go decision points and go/no-go decision criteria for the proposed project
- Experience of the Principal Investigator and the project team in performing research in this discipline or related areas; adequacy of the relevant facilities

For successful preliminary applicants, scores and rankings under the preliminary review will be discarded and will not be used for evaluation of the final applications.

##### **EVALUATION CRITERIA FOR FINAL APPLICATIONS**

The following evaluation criteria will be used in the comprehensive evaluation of final applications. For each criterion, the weighting (out of a total of 100%) is indicated to show the relative importance.

##### **a) Technical Concept (Weight: 60%)**

- The relevance of the technical concept to the technical objectives of the announcement; the extent to which the proposed concept offers advantages over current emerging technologies and methodologies

- The feasibility of the proposed technical concept and soundness of the research program
- The identification of the key technical risk areas of the proposed concept and how the applicant plans to address them
- The potential of the proposed concept to advance the technology and to achieve DOE's specific technical performance targets for on-board storage systems

**b) Work Plan (Weight: 25%)**

**Statement of Objectives**

- The relevance and clarity of the goals and objectives of the project
- The likelihood of success of the proposed work plan to meet the project goals
- The clarity, adequacy and reasonableness of the work breakdown structure and task descriptions
- The adequacy, clarity and timing of major milestones
- The clarity and adequacy of technical project deliverables, including the specific end result of each phase of the project; the extent to which the deliverables will advance the state-of-the art
- The adequacy, clarity and timing of go/no-go points (e.g. achieving x wt% hydrogen storage material capacity) as well as the quantitative criteria for how these go/no-go decisions will be made

**Project Management**

- The adequacy of the proposed project organization to facilitate project success
- The clarity and appropriateness of the roles of the team members
- The approach to managing the team and ensuring communication among team members
- Adequately addresses safety, particularly handling of hydrogen and handling of potentially hazardous materials

**c) Qualifications and Facilities (Weight: 15%)**

**Personnel and Organization Qualifications**

- The adequacy of the education, professional training, technical skills, and work experience of the Principal Investigator (PI) and other key personnel, including personnel from major subcontractors
- The level and reasonableness of the time commitment of the PI and other key personnel, including personnel from major subcontractors, assigned to the proposed project

- The capability of the proposed team to address all aspects of the proposed work
- The relevant experience of each organization on the proposed team in performing similar projects

#### **Facilities**

- The adequacy of the applicant's existing facilities, and those of subcontractors, proposed for completing the work
- The reasonableness of any request for new facilities or equipment

For the final application, the proposed cost elements will not be point scored or adjectivally rated. However, they will be evaluated to determine if the total proposed amount is commensurate with the proposed effort.

### **3. Other Selection Factors**

The selection official will consider the following program policy factors in the selection process:

- Selection of applications to achieve a balance of complementary projects, in conjunction with existing projects funded by the DOE Hydrogen Program, to meet the overall goals and objectives of that Program
- Selection of projects involving a diversity (types and sizes) of proposing organizations and technologies
- Selection of applications with comparatively significant cost/benefit advantages
- Selection of applications with applicant cost share above the minimum level required
- Geographic distribution of applicants within the U.S.
- Past performance of applicants on previous Federal awards

## **B. Review and Selection Process**

### **1. Merit Review**

After passing the initial review, preliminary applications will undergo a preliminary merit review process where applications are evaluated and scored according to the Evaluation Criteria for Preliminary Applications listed in Section IV.A.2 above. Selected preliminary applicants will then be notified by letter of the favorable results of the preliminary merit review and will be encouraged to submit a final application. Unsuccessful preliminary applicants will also be notified by letter of the results of the preliminary merit review and will be eliminated from further consideration. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications. Final applications will then be evaluated, scored, and ranked according to the Evaluation Criteria for Final Applications listed in Section IV.A.2 above by a final objective merit review committee. The final merit review committee will make recommendations to the

Selection Official as to whether or not each final application is determined to be worthy of funding based exclusively on the technical strengths and weaknesses of the application.

Applications for Category 1 and for Category 2 (and for both) will be evaluated using the same criteria, regardless of category designation. The potential for an applicant to become a member in a Center of Excellence will be considered by DOE only after selections are made and will have no bearing on the evaluation and selection process. The technical evaluation criteria and program policy factors are identical for both categories.

## **2. Non-governmental Reviewers**

In conducting this evaluation, and as indicated above, the Government may utilize assistance and advice from non-Government personnel. Applicants are therefore requested to state on the cover sheet of the applications if they do not consent to an evaluation by such non-Government personnel. The applicants are further advised that DOE may be unable to give full consideration to an application submitted without such consent.

## **3. Selection**

The Selection Official will consider the merit review recommendation, program policy factors, and the amount of funds available in making selection decisions.

## **4. Debriefings**

Organizations whose applications have not been selected will be advised as promptly as possible. For applicants who do not pass the initial review, this notice will consist of the findings of the initial review as determined by DOE/GO. For applicants who go forward to the comprehensive review, this notice will consist of the consensus strengths and weaknesses as determined by the Merit Review Committees.

## **5. Discussions and Award**

The Government may enter into discussions with a selected applicant for any reason deemed necessary, including but not limited to: (1) the budget is not appropriate or reasonable for the requirement; (2) only a portion of the application is selected for award; and/or (3) special terms and conditions are required. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

## **C. Anticipated Notice of Selection and Award Dates**

DOE plans to send invitations to submit final applications to successful preliminary applicants by **August 4, 2006**. Note: Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.

DOE anticipates notifying applicants selected for award and making awards early in Fiscal Year 2007.



## **V. GENERAL CONDITIONS**

### **A. Partial Awards**

DOE reserves the right to support or to not support all, or any part of, any application. Unsuccessful applications will not be returned.

### **B. Debarred and Suspended Parties**

Applicants must not make any sub-award or permit any sub-award to any party which is debarred, suspended, or is otherwise excluded from or ineligible for Federal awards. The list of parties excluded from Federal procurement and non-procurement programs can be accessed through the Excluded Parties List System (EPLS) at <http://epls.arnet.gov>.

### **C. National Environmental Policy Act (NEPA) Requirements**

All applicants selected for negotiations shall complete the necessary NEPA compliance requirements in coordination with their local DOE Field Office. Documentation of the completed NEPA documentation will need to be provided prior to awarding funding for the project. Applicants are restricted from taking an irreversible action prior to DOE reaching a final NEPA decision regarding a proposed project. Irreversible actions include demolition of existing buildings, site clearing, ground breaking, construction, and/or site-specific detailed design. Provided DOE has authorized the work, this restriction does not preclude the applicant from developing plans, preliminary designs, or performing other necessary support work prior to DOE reaching its final NEPA decision.

### **D. Reporting**

In addition to the progress reports provided by National Laboratories to DOE, reporting requirements will include the following:

- Annual presentation at the DOE Hydrogen Program Annual Merit Review and Peer Evaluation Meeting (typically in Washington, D.C.)
- Annual presentation at DOE/FreedomCAR and Fuel Partnership Hydrogen Storage Technical Team Meeting (typically in Detroit, MI)
- Annual submission to the DOE Hydrogen Program's Annual Progress Report
- Safety Plan

### **E. Intellectual Property Developed Under This Program**

Patent Rights in any inventions that are conceived or first actually reduced to practice under awards made from this Program Announcement and any rights in technical data created under such awards, will be governed by the terms and conditions of the Management and Operating (M&O) Contract of the applicant or applicants receiving an award and also will be governed by any applicable class patent waivers executed for that M&O Contract.

**F. Data Protection Statute**

This program is covered by a special data protection statute. See Energy Policy Act of 2005, P.L. 109-58, Section 810. The provisions of the statute provide for the protection from public disclosure, for a period of up to five years for data first produced in the performance of funded activities.

## APPENDIX A – DEFINITIONS

**“Amendment”** means a revision to a solicitation or lab call.

**"Applicant"** means the legal entity or individual signing the application. This entity or individual may be one organization or a single entity representing a group of organizations (such as a Consortium) that has chosen to submit a single application in response to an announcement.

**"Application"** means the documentation submitted in response to an announcement. NOTE: Application is referred to as Proposal in IIPS.

**"Award"** means the written documentation executed by a DOE Contracting Officer, after an applicant is selected, which contains the negotiated terms and conditions for performing the work.

**"Budget"** means the cost expenditure plan submitted in the application, including both the DOE contribution and any applicable cost share.

**"Consortium (plural consortia)"** means the group of organizations or individuals that have chosen to submit a single application in response to a solicitation or lab call.

**"Contracting Officer"** means the DOE official authorized to execute Awards on behalf of DOE and who is responsible for the business management and non-program aspects of the contracting process.

**"Cost Sharing"** means the respective share of total project costs to be contributed by the applicant and by DOE. The percentage of applicant cost share is to be applied to the total project cost (i.e., the sum of applicant plus DOE cost shares) rather than to the DOE contribution alone.

**“Data Universal Numbering System (DUNS) Number”** is a unique nine-character identification number issued by Dun and Bradstreet (D&B). Organizations must have a DUNS number prior to registering in the CCR. Call 1-866-705-5711 to receive one free of charge. <http://www.grants.gov/RequestaDUNS>

**“Industry Interactive Procurement System (IIPS)”** is DOE’s Internet-based procurement system which allows access to DOE’s business opportunities database, allows user registration and submittal of applications: <http://e-center.doe.gov/>.

**"Key Personnel"** means the individuals who will have significant roles in planning and implementing the proposed Project on the part of the applicant and Participants.

**"Participant"** means any entity substantially involved in a Consortium, or other business arrangement (including all parties to the application at any tier), responding to the lab call.

**"Project"** means the set of activities described in an application, State plan, or other document that is approved by DOE.

**“Proposal”** is the term used in IIPS meaning the documentation submitted in response to an announcement. Also see application.

**“Recipient”** means the organization, individual, or other entity that receives an award from DOE, is financially accountable for the use of any DOE funds or property provided for the performance of the project, and is legally responsible for carrying out the terms and condition of the award.

**"Selection"** means the determination by the DOE Selection Official that negotiations take place for certain projects with the intent of making an award.

**"Selection Official"** means the DOE official designated to select applications for negotiation toward award under a subject solicitation or program announcement.

**"Total Project Cost"** means all the funds to complete the effort proposed by the applicant, including DOE funds plus all other funds that will be committed by the applicant as cost sharing.

**APPENDIX B – INDUSTRY INTERACTIVE PROCUREMENT SYSTEM (IIPS) 3.5**

**FOR HELP, CONTACT THE IIPS HELP DESK AT 1-800-683-0751 (SELECT OPTION 1)  
OR AT [IIPS\\_HELPDESK@E-CENTER.DOE.GOV](mailto:IIPS_HELPDESK@E-CENTER.DOE.GOV)**

**1. Locate Announcement/Amendments**

- Go to the IIPS website at <http://e-center.doe.gov>
- Click on “Browse Opportunities” and scroll down to view DOE Financial Assistance Opportunities (Viewing “Opportunities by Contracting Activity” is recommended.) Click on the “Browse Financial Asst.” button **OR** Click on the “Login” button if you are already registered. Click on the radio button that says “IIPS - Financial Assistance” and click on the “Login” button again. Enter User Name and Password. Click on any of the options for viewing the Funding Opportunity Announcement, whichever is easiest for you to locate the Announcement. (Viewing “Opportunities by Contracting Activity” is recommended.)
- Click on folder (or blue arrow depending on your server) next to the “Golden Field Office”
- Locate and click on the Announcement number to view the “Financial Assistance Opportunity.”
- Scroll to the bottom of the page, where you will find the attached announcement, under “Full Announcement & Other Files.”

**2. View Announcement Messages/Amendments**

- Click on the folder next to the Announcement number to view amendments and announcement messages.

**3. IIPS Registration**

An applicant only has to register once on IIPS. This registration is permanent and is used for all IIPS submissions. If the applicant has already registered, it is unnecessary to register again. If an applicant has not previously registered, it is encouraged to register in IIPS at least 14 days prior to the Announcement closing date. To register:

- Go to the IIPS website at <http://e-center.doe.gov>.
- Click on the “Register” button.
- Click on the radio button next to, “Check this box for IIPS” and then click on the “Proceed to Form” button.
- Read the “Notice of Disclaimer” and click on “I Accept” if you are in agreement. (Clicking on “I Decline” will return you to the main registration page.)
- Complete the Registration Form. Also print this page, which contains your password, for future reference.
- Click on “Submit Registration.” Applicants will receive a confirmation of receipt of registration.
- Applicants will also receive an email confirming successful registration. If an applicant does not receive this email confirmation within one business day, contact the IIPS Help Desk.

**4. Join Mailing List**

It is highly recommended that applicants join the mailing list, to receive announcement messages.

- To do so, follow the direction in item 1. Locate Announcement, and then click on the “Join Mailing List” button, enter the required information, and submit.

- After an applicant has joined the mailing list, the applicant will receive an email each time an announcement message is posted.
- However, the applicant should visit the announcement page periodically to ensure receipt of the latest information.

#### 5. Electronic Submission

Applications must be submitted in accordance with the instructions in the announcement.

#### 6. Electronic Signature

Applications submitted through IIPS constitute submission of electronically signed applications. The name of the authorized organizational representative (i.e., the administrative official, who, on behalf of the proposing organization, is authorized to commit the applicant to the conduct of a project) must be typed in the signature block on the form to be accepted as an electronic signature. A scanned copy of the signed documents is not required.

#### 7. Submit Application

Applicants are strongly encouraged to submit applications at least 48 hours prior to the deadline for submissions to ensure timely submission and allow time to resolve any possible transmission problems. To submit an application, follow these steps:

##### Step 1 – Prepare Application

All required files necessary for a complete application package should be prepared in accordance with the instructions in the announcement prior to starting the transmission process. Files should be completed, organized and named as instructed in Announcement part entitled “Application Content” before proceeding to submit an application. Applicants should submit the entire package in one IIPS session (do not logoff before all the files are attached).

##### Step 2 – Create Application

- Enter the IIPS website at <http://e-center.doe.gov>.
- Click on the “Login” button.
- Click on the radio button that says, “IIPS - Financial Assistance” and click on “Login” button again.
- Enter your user name (as shown on your registration email confirmation) and password. Note: These are case sensitive.
- Click on any of the options for viewing the Announcement (Opportunity), whichever is easiest for you to locate the announcement. (Viewing “Opportunities by Contracting Activity” is recommended.)
- Click on the folder (or blue arrow) next to the Golden Field Office.
- Locate the Announcement for which you are applying and click on it.
- Click on the “Create Application” button and complete the information on the application Cover Page. In order for DOE to accurately identify each application, applicants must enter a unique project title in the “Subject” line.
- Click on “Continue”.

##### Step 3 – Attach Application

- Click on “Attach Application”.
- Scroll to the bottom of the page and attach each file in the corresponding block on the page, as outlined in the announcement, and then click on “Submit.” Up to 10 files may be attached. Keep file sizes to a minimum to ensure a shorter transmission time. Be patient while your files upload.
- IIPS will provide a “Submission Confirmation” with a tracking number, please print this page for your records

Once the applicant begins the "Create Application" process, there will be a record created in IIPS. Therefore, applicants must verify that duplicate applications were not inadvertently created in IIPS. If a duplicate was created, follow the steps outlined in Appendix B, Item 9.a.

**In the event that two or more applications are received from the same applicant with the same unique project title, only the application with the LATEST transmission start time will be considered for review. The application must be received on time.**

#### 8. Multiple Applications for Unique Projects

An applicant may submit more than one application under the same announcement; however, each application must be uniquely titled. For each application, the applicant is required to follow the instructions in "Submit Application." Each application must be complete and shall not rely upon another application as submission of the required documents.

#### 9. Deletion of Applications

##### I. To delete an application (including all files) from IIPS:

To delete or withdraw an application or an application file, contact the IIPS Help Desk requesting the application to be removed. The following information is required when requesting to have an application deleted:

- A. Registered User's Name as well as User Name of requestor (if different)
- B. Email address of the registered user as well as requester (if different)
- C. Company/University Name
- D. Complete Announcement Number
- E. Complete Proposal Tracking Number
- F. Date Submitted (optional)

In addition, if an application is deleted after the closing date, inform the Contract Specialist shown on the announcement, via email.

##### II. To submit a revised application:

After the Help Desk has removed the requested application, follow the steps in "Submit Application" to submit a revised application (i.e. cover page and all required files).

##### III. To submit a revised file:

After the Help Desk has removed the requested file from your application:

- Locate the announcement.
- Click on the yellow folder next to the announcement number.
- Click on the cover page of your submission, click on the "Attach Application" link, and attach the revised file. Files received past the due date will not be reviewed.

#### 10. IIPS Questions

View the "IIPS Frequently Asked Questions" by clicking on the "Help" button and scrolling to the bottom of the page. You may also contact the IIPS Help Desk at 1-800-683-0751 (select Option 1) or at [IIPS\\_HelpDesk@e-center.doe.gov](mailto:IIPS_HelpDesk@e-center.doe.gov) for questions regarding the operation of IIPS.

#### 11. Submit a Question on the Content of the Announcement

"Locate Announcement", then click on the "Submit Question" button and enter required information. You will receive an electronic notification when your question has been answered. DOE EERE will respond to a question within 5 business days, unless a similar question and answer have already been posted.

## 12. View Questions and Answers

"Locate Announcement", then click on the "View Questions" button. If no questions have been submitted and answered, a statement to that effect will appear. Potential applicants should periodically check the IIPS website for new questions and answers.

**IIPS Resources** **A-Z IIPS User Guide**—anything and everything the applicant would ever want to know about IIPS. This user guide can be found at: <http://e-center.doe.gov/doebiz.nsf/Help?OpenForm> by scrolling to the bottom of the page.



## APPENDIX C – TECHNOLOGY TOPICS

### TECHNICAL CHALLENGES

For transportation, the overarching technical challenge for hydrogen storage is how to store the amount of hydrogen required for a conventional driving range (greater than 300 miles), within the vehicular constraints of weight, volume, efficiency, safety, and cost. Durability over the performance lifetime of these systems, as well as acceptable refueling times and hydrogen delivery flow rates must be achieved. The key technical challenges for all approaches of vehicular storage include:

- **System Volume and Weight.** The volume and weight of hydrogen storage systems are presently too high, resulting in inadequate vehicle range compared to conventional petroleum fueled vehicles. Storage media, materials of construction and components are needed that allow compact, lightweight hydrogen storage systems while enabling greater than 300-mile range in all light-duty vehicle platforms. Reducing weight and volume of thermal management components is also required.
- **System Cost.** The cost of on-board hydrogen storage systems is too high, particularly in comparison with conventional storage systems for petroleum fuels. Low-cost storage media, materials of construction and components for hydrogen storage systems are needed, as well as low-cost, high-volume manufacturing methods.
- **Efficiency.** Energy efficiency is a challenge for all hydrogen storage approaches. The energy required to get hydrogen in and out is an issue for on-board reversible materials. Life-cycle energy efficiency is a challenge for chemical hydrogen storage in which the by-product is regenerated off board the vehicle. Thermal management for charging and releasing hydrogen from the storage system needs to be optimized to increase overall efficiency for all approaches.
- **Durability/ Operability.** Durability of hydrogen storage systems is inadequate. Storage media, materials of construction and balance-of-plant components are needed that allow hydrogen storage systems with a lifetime of at least 1500 cycles and with tolerance to hydrogen fuel contaminants. An additional durability issue for material-based approaches is the delivery of sufficient quality hydrogen for the vehicle power plant.
- **Charging/ Discharging Rates.** In general and especially for material-based approaches, hydrogen refueling times are too long. There is a need to develop hydrogen storage systems with refueling times of less than three minutes for a 5-kg of hydrogen charge, over the lifetime of the system. Thermal management that enables quicker refueling is a critical issue that must be addressed. Also, all storage system approaches must be able to supply sufficient flow rate of hydrogen to the vehicle power plant (e.g. fuel cell or internal combustion engine) to meet the required power demand.
- **Thermal Management.** Approaches are needed to address heat input and removal requirements both during hydrogen charging and discharging for all technologies. In general, the main technical challenge is heat removal upon re-filling of hydrogen for on-board reversible materials within fueling time requirements. On-board reversible materials typically require heat to release hydrogen on board the vehicle. Heat must be provided to the storage media at reasonable temperatures to meet the flow rates needed by the vehicle power plant, preferably using the waste heat of the power plant. Depending upon the chemistry, chemical hydrogen approaches often are exothermic upon release of hydrogen to the power plant, or optimally thermal neutral. By virtue of

the chemistry used, chemical hydrogen approaches require significant energy to regenerate the spent material and by-products prior to re-use; this done off the vehicle.

- **Codes & Standards.** Applicable codes and standards for hydrogen storage systems and interface technologies, which will facilitate implementation/commercialization and assure safety and public acceptance, have not been established. Standardized hardware and operating procedures, and applicable codes and standards, are required.
- **Life-Cycle and Efficiency Analyses.** Systematic analyses for the full life-cycle cost, efficiency, and environmental impact for hydrogen storage systems are required.

Additional issues specific to reversible material-based hydrogen storage systems (i.e. materials that may be charged and discharged reversibly on board a vehicle) are:

- **Lack of Understanding of Hydrogen Physisorption and Chemisorption.** Fundamental understanding of hydrogen physisorption and chemisorption processes is lacking. Improved understanding and optimization of adsorption/absorption and desorption kinetics are needed to optimize hydrogen uptake and release capacity rates. An understanding of chemical reactivity and material properties, particularly with respect to exposure under different conditions (air, moisture, etc.) is also lacking.
- **Reproducibility of Performance.** Standard test protocols for evaluation of hydrogen storage materials are lacking. Reproducibility of performance both in synthesis of the material/media and measurement of key hydrogen storage performance metrics is an issue. Standard test protocols related to performance over time such as accelerated aging tests as well as protocols evaluating materials safety properties and reactivity over time are also lacking.

Additional issues specific to chemical hydrogen storage systems (i.e. materials that may discharge hydrogen on board but need to be regenerated off board) are:

- **Regeneration Processes.** Low-cost, energy efficient regeneration processes have not been established. Full life-cycle analyses need to be performed to understand cost, efficiency and environmental impacts.
- **By-Product/Spent Material Removal.** The refueling process is potentially complicated by removal of the by-product and/or spent material. System designs must be developed to address this issue and the infrastructure requirements for off-board regeneration.

The current status of various approaches are monitored continuously by DOE and compared to DOE system targets. Any proposed approaches should show potential to meet or exceed DOE's 2010 targets with potential to meet the 2015 targets.

## GOALS AND TECHNICAL TARGETS

The goal of the DOE hydrogen storage activity is to fund the research and development of viable hydrogen storage technologies primarily for on-board vehicular applications. The major objectives for on-board vehicular hydrogen storage are:

- By 2010, develop and verify on-board hydrogen storage systems achieving 2 kWh/kg (6 wt.%), 1.5 kWh/Liter, and \$4/kWh.

- By 2015, develop and verify on-board hydrogen storage systems achieving 3 kWh/kg (9 wt.%), 2.7 kWh/Liter, and \$2/kWh.

Table 1 shows the technical targets for on-board hydrogen storage systems<sup>3</sup>. The technical targets for on-board hydrogen storage systems were established through the FreedomCAR partnership between DOE and the U.S. Council of Automotive Research (USCAR). The partnership was recently expanded to include the major energy companies and renamed the FreedomCAR and Fuel Partnership<sup>4</sup>.

---

<sup>3</sup> See the following websites for more details on the targets:  
[http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/freedomcar\\_targets\\_explanations.pdf](http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/freedomcar_targets_explanations.pdf) and  
<http://www.eere.energy.gov/hydrogenandfuelcells/mypp>.

<sup>4</sup> The FreedomCAR and Fuel Partnership includes U.S. Department of Energy, USCAR (DaimlerChrysler Corporation, Ford Motor Company and General Motors Corporation), BP America, ChevronTexaco, ConocoPhillips, ExxonMobil Corporation and Shell Hydrogen U.S.

Table 1 Technical Targets: On-Board Hydrogen Storage Systems <sup>a,b,c</sup>

Storage Parameter	Units	2007	2010	2015
System Gravimetric Capacity: <b>Usable, specific-energy from H<sub>2</sub> (net useful energy/max system mass)<sup>d</sup></b>	<b>kWh/kg (kg H<sub>2</sub>/kg system)</b>	<b>1.5 (0.045)</b>	<b>2 (0.06)</b>	<b>3 (0.09)</b>
System Volumetric Capacity: <b>Usable energy density from H<sub>2</sub> (net useful energy/max system volume)</b>	<b>kWh/L (kg H<sub>2</sub>/L system)</b>	<b>1.2 (0.036)</b>	<b>1.5 (0.045)</b>	<b>2.7 (0.081)</b>
Storage system cost <sup>e</sup>  (& fuel cost) <sup>f</sup>	<b>\$/kWh net (\$/kg H<sub>2</sub>) \$/gge at pump</b>	<b>6 (200) ---</b>	<b>4 (133) 2-3</b>	<b>2 (67) 2-3</b>
Durability/Operability <ul style="list-style-type: none"> <li>Operating ambient temperature <sup>g</sup></li> <li>Min/max delivery temperature</li> <li>Cycle life variation <sup>h</sup></li> <li>Cycle life (1/4 tank to full) <sup>i</sup></li> <li>Min delivery pressure from tank; FC= fuel cell, l=ICE</li> <li>Max delivery pressure <sup>j</sup></li> </ul>	°C °C % of mean (min) at % confidence Cycles  Atm (abs) Atm (abs)	-20/50 (sun) -30/85 N/A 500  8FC / 10ICE 100	-30/50 (sun) -40/85 90/90 1000  4FC / 35ICE 100	-40/60 (sun) -40/85 99/90 1500  3FC / 35ICE 100
Charging/discharging Rates <ul style="list-style-type: none"> <li>System fill time (for 5 kg)</li> <li>Minimum full flow rate</li> <li>Start time to full flow (20 °C) <sup>k</sup></li> <li>Start time to full flow (- 20 °C) <sup>k</sup></li> <li>Transient response 10%-90% and 90% - 0%<sup>l</sup></li> </ul>	min (g/s)/kW s s s	10 0.02 15 30 1.75	3 0.02 5 15 0.75	2.5 0.02 5 15 0.75
Fuel Purity (H <sub>2</sub> from storage) <sup>m</sup>	<b>% H<sub>2</sub></b>	<b>99.99 (dry basis)</b>		
Environmental Health & Safety <ul style="list-style-type: none"> <li>Permeation &amp; leakage <sup>n</sup></li> <li>Toxicity</li> <li>Safety</li> <li>Loss of useable H<sub>2</sub> <sup>o</sup></li> </ul>	Scc/h - -  (g/h)/kg H <sub>2</sub> stored	<b>Meets or exceeds applicable standards</b>		
		<b>1</b>	<b>0.1</b>	<b>0.05</b>

## Footnotes to Table 1:

- a. Based on the lower heating value of hydrogen and greater than 300-mile vehicle range; targets are for complete system, including tank, material, valves, regulators, piping, mounting brackets, insulation, added cooling capacity, and/or other balance-of-plant components.

- b. Unless otherwise indicated, all targets are for both internal combustion engine and for fuel cell use, based on the low likelihood of power-plant specific fuel being commercially viable.
- c. Systems must be energy efficient. For reversible systems, greater than 90% energy efficiency for the energy delivered to the power plant from the on-board storage system is required. For systems regenerated off-board, the energy content of the hydrogen delivered to the automotive power plant should be greater than 60% of the total energy input to the process, including the input energy of hydrogen and any other fuel streams for generating process heat and electrical energy. This is based on the DOE on-board target of 90% efficiency and the DOE off-board energy efficiency targets of 79% for hydrogen produced from natural gas and 85% for well-to-tank efficiency.
- d. Generally the 'full' mass (including hydrogen) is used, for systems that gain weight, the highest mass during discharge is used.
- e. 2003 US\$; total cost includes any component replacement if needed over 15 years or 150,000 mile life.
- f. 2001 US\$; includes off-board costs such as liquefaction, compression, regeneration, etc; 2015 target.
- g. Stated ambient temperature plus full solar load No allowable performance degradation from -20C to 40C. Allowable degradation outside these limits is TBD.
- h. All targets must be achieved at end of life.
- i. Equivalent to 100,000; 200,000; and 300,000 miles respectively (current gasoline tank spec).
- j. In the near term, the forecourt should be capable of delivering 10,000 psi compressed hydrogen, liquid hydrogen, or chilled hydrogen (77 K) at 5000 psi. In the long term, it is anticipated that delivery pressures will be reduced to between 50 and 150 atm for solid state storage systems, based on today's knowledge of sodium alanates.
- k. Flow must initiate within 25% of target time.
- l. At operating temperature.
- m. For fuel cell systems, meets ISO/PDTS 14687-2. Total non-particulates, 100 ppm; H<sub>2</sub>O, 5 ppm; total hydrocarbons (C<sub>1</sub> basis), 2 ppm; O<sub>2</sub>, 5 ppm; He, N<sub>2</sub>, Ar combined, 100 ppm; CO<sub>2</sub>, 10 ppm; CO, 0.2 ppm; total S, 0.004 ppm; HCHO, 0.01 ppm; HCOOH, 0.2 ppm; NH<sub>3</sub>, 0.1 ppm; total halogenates, 0.05 ppm; maximum particle size, <10 µm, particulate concentration, <10µg/L H<sub>2</sub>. The storage system will not provide any purification, but will receive incoming hydrogen at the purity levels required for the fuel cell. Some storage technologies may produce contaminants for which effects are unknown; these will be addressed as more information becomes available.
- n. Total hydrogen lost into the environment as H<sub>2</sub>; relates to hydrogen accumulation in enclosed spaces. Storage system must comply with CSA/NGV2 standards for vehicular tanks. This includes any coating or enclosure that incorporates the envelope of the storage system.
- o. Total hydrogen lost from the storage system, including leaked or vented hydrogen; relates to loss of range.

## THE NATIONAL HYDROGEN STORAGE PROJECT

The Department of Energy has conducted a series of workshops to identify R&D needs and to assess priorities and strategies for on-board hydrogen storage. These include a Hydrogen Storage Materials Workshop held in August 2002, a Hydrogen Storage “Think Tank” Meeting held in March 2003, and a Basic Energy Sciences Workshop held in May 2003. The proceedings of these workshops are available on DOE websites at [http://www.eere.energy.gov/hydrogenandfuelcells/wkshp\\_h2\\_storage.html](http://www.eere.energy.gov/hydrogenandfuelcells/wkshp_h2_storage.html); [http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/h2\\_storage\\_think\\_tank.pdf](http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/h2_storage_think_tank.pdf); and [http://www.sc.doe.gov/bes/reports/files/NHE\\_rpt.pdf](http://www.sc.doe.gov/bes/reports/files/NHE_rpt.pdf).

Based on the findings from these workshops, the DOE issued a “Grand Challenge” to the global scientific community for research in hydrogen storage in July 2003. This Grand Challenge called for the establishment of hydrogen storage Centers of Excellence in Metal Hydrides, Chemical Hydrogen Storage, and Carbon-Based Materials, with multiple university, industry, and federal laboratory partners. In addition, independent projects were solicited on new materials and concepts, off-board hydrogen storage systems, and analyses of life cycle cost, performance and environmental impact. Complementing the Grand Challenge, the DOE Office of Science issued a solicitation in 2004 for basic research to help overcome key hurdles in hydrogen production, storage, and conversion.

The DOE Centers of Excellence and independent projects, together with existing DOE hydrogen storage efforts, constitute the framework of the National Hydrogen Storage Project. The Metal Hydride Center includes Sandia National Laboratory in Livermore, California and multiple university, industry and federal laboratory partners. The Metal Hydride Center focuses on the development of advanced metal hydride materials including light-weight advanced complex hydrides, destabilized binary hydrides, intermetallic hydrides, modified lithium amides, and other on-board reversible hydrides. The Chemical Hydrogen Storage Center includes the Los Alamos National Laboratory in Los Alamos, New Mexico, the Pacific Northwest National Laboratory in Richland, Washington, and multiple university and industry partners. The Chemical Hydrogen Center focuses on three “tiers” of R&D for chemical hydrogen storage: borohydride-water systems, novel boron chemistry, and innovation beyond boron. The Carbon-Based Materials Center includes the National Renewable Energy Laboratory in Golden, Colorado and multiple university, industry and federal laboratory partners. The Carbon-Based Materials Center focuses on breakthrough concepts for storing hydrogen in high surface area adsorbents such as hybrid carbon nanotubes, aerogels, and nanofibers, as well as metal-organic frameworks and conducting polymers. The National Hydrogen Storage Project also involves independent projects on new hydrogen storage materials and concepts, material and system testing, and system analyses.

## SCOPE OF ANNOUNCEMENT

DOE is soliciting applications for the research and development of innovative technologies for on-board vehicular hydrogen storage. Further information on the hydrogen program can be obtained from the Multi-Year Program Plan at [www.eere.energy.gov/hydrogenandfuelcells/mypp](http://www.eere.energy.gov/hydrogenandfuelcells/mypp), and from the DOE Hydrogen Program’s Annual Progress Reports at [http://www.hydrogen.energy.gov/annual\\_progress05.html](http://www.hydrogen.energy.gov/annual_progress05.html) and [http://www.hydrogen.energy.gov/annual\\_progress04.html](http://www.hydrogen.energy.gov/annual_progress04.html).

It is intended that this announcement will be issued on an annual basis, subject to congressional appropriations and direction. New projects will be selected each fiscal year based on technical merit review, program policy review and the availability of funds. Projects will typically be of two to five-year duration, with overall go/no-go decision points between the phases. The project schedule should take into consideration the meeting of key milestones in the Multi-Year Program Plan mentioned above.

The application process will include two phases -- a preliminary application phase and a final application phase. Only applicants who are favorably selected in the preliminary application phase will be eligible to submit final applications.

The technical topics listed below under Categories 1 and 2 are the only eligible research areas under this announcement.

Applicants seeking to become a partner in a Center of Excellence should apply to Category 1. The appropriate Center should be clearly stated on the cover page of the application. If the work is applicable to more than one Center, then each applicable Center should be listed on the cover page.

Applicants not seeking to become a partner in a Center of Excellence should apply only to Category 2. The appropriate technical topic should be clearly stated on the cover page of the application.

Applicants may apply for both Category 1 and Category 2 with the same application, provided that the application meets the technical topic requirements for both categories as described below. However, applicants should not submit separate applications for the same project under both categories. Duplicate applications will not be reviewed separately. Applicants wishing to apply to both categories with the same application must state both the appropriate Category 1 Center of Excellence and the appropriate Category 2 technical topic on the cover page of their application. Category 1 applications will not be considered for award under Category 2 unless the application clearly states the applicant's intention to apply for both categories with the same application.

For either category (or both), applicants may not submit an application that covers more than one technical topic, (i.e., separate applications must be submitted for separate technical topics).

Applications for Category 1 and for Category 2 (and for both) will be evaluated using the same criteria, regardless of category designation. The potential for an applicant to become a member in a Center of Excellence will be considered by DOE only after selections are made and will have no bearing on the evaluation and selection process. The technical evaluation criteria and program policy factors are identical for both categories.

### **Category 1:**



Category 1 proposals are intended to maintain the vitality and flexibility of the Centers of Excellence by establishing new technical approaches and/or new experimental or theoretical capabilities that are compatible with the overall Center objectives.

Projects are sought that are supportive of and complementary to the activities of any of the existing Hydrogen Storage Centers of Excellence in Metal Hydrides, Chemical Hydrogen Storage, and Carbon-Based Materials. Such projects must help establish important new technical approaches or capabilities not presently available at the Centers. A successful applicant may become a Center partner, provided that the applicant signs an existing non-disclosure agreement that has been signed by each of the existing Center partners. The appropriate Center of Excellence must be clearly stated on the cover page of the application. If the work is applicable to more than one Center, then each applicable Center should be listed on the cover page.

The existing partners' work within each of the Centers of Excellence can be found in the DOE Hydrogen Program's Annual Progress Reports at [http://www.hydrogen.energy.gov/annual\\_progress05.html](http://www.hydrogen.energy.gov/annual_progress05.html) and [http://www.hydrogen.energy.gov/annual\\_progress04.html](http://www.hydrogen.energy.gov/annual_progress04.html). The National Hydrogen Storage Project background can be found at [http://www.eere.energy.gov/hydrogenandfuelcells/storage/national\\_proj.html](http://www.eere.energy.gov/hydrogenandfuelcells/storage/national_proj.html).

Category 1 applicants are encouraged to research the ongoing Center work at the various websites referenced in this announcement. The current Center objectives are given below.

**DOE Metal Hydride Center of Excellence:**

The DOE Metal Hydride Center focuses on the development of advanced metal hydride materials, including lightweight, high-capacity complex hydrides; destabilized binary hydrides; intermetallic hydrides; modified lithium amides; and other onboard reversible hydrides. The Metal Hydride Center has two main objectives: (1) develop improved lightweight, high-capacity hydride-based materials for vehicular applications, and (2) pursue systems engineering science for the ultimate integration and demonstration of these advanced materials into a complete hydrogen storage and delivery system.

The DOE Metal Hydride Center proposes to develop an advanced hydrogen storage system based on parallel research in four classes of hydride-based materials. These include 1) advanced complex hydrides of the light elements Li, Na, Mg, Ti, Ca, B, Al, Si; 2) destabilized binary hydrides (e.g. Li-Si destabilized H<sub>2</sub> release from LiH); 3) novel intermetallic hydrides (e.g. Mg-M-H alloys); and 4) other on-board reversible hydride materials, such as lithium amides, that demonstrate promising hydrogen storage properties.

The Center will ultimately select and demonstrate a prototype hydrogen storage system that has the potential to meet DOE's hydrogen storage performance goals.

**DOE Chemical Hydrogen Storage Center of Excellence:**

The DOE Chemical Hydrogen Storage Center of Excellence focuses on developing advanced chemical hydrogen storage materials and studying their associated engineering requirements for on-board vehicular applications. The goal of the center is to develop an advanced hydrogen



storage system by pursuing three “tiers” of R&D for chemical hydrogen storage that most likely will require off-board regeneration.

Tier 1, Borohydride/Water, concentrates on the chemistry required for facile reaction of borohydride,  $\text{BH}_4^-$ , compounds such as  $\text{NaBH}_4$  with water to release hydrogen, and for lowering the cost of converting the resulting borates back to  $\text{BH}_4^-$ . The overall goal of Tier 1 is to develop new chemistry and study its engineering requirements to remove barriers to implementation of  $\text{NaBH}_4$  technology for hydrogen storage.

Tier 2, Novel Boron Chemistry, addresses the possibility that the expense of converting B-O bonded species back to  $\text{BH}_4^-$  could remain unacceptably high, and focuses on chemical processes that release hydrogen from other B-H bonded species that may be less energy-intensive and less expensive to regenerate than borohydride. The overall goal of Tier 2 is to design and develop new boron-hydride chemistry and study its engineering requirements with improved thermodynamics for regeneration of spent material after hydrogen release.

Tier 3, Innovation beyond Boron, examines materials comprising light elements other than boron that could satisfy non-toxicity and mass/volume-storage requirements for serving as useful sources of hydrogen, while at the same time requiring minimal energy cost of recycling/regenerating. The overall goal of Tier 3 is to identify and develop new compounds and materials and study their engineering requirements for chemical hydrogen storage.

The Center will ultimately select and demonstrate a prototype hydrogen storage system that has the potential to meet DOE’s hydrogen storage performance goals.

#### **DOE Carbon-Based Materials Center of Excellence:**

The DOE Center of Excellence on Carbon-Based Materials focuses on developing high surface area adsorbents and carbon-based materials for vehicular hydrogen storage systems that are reversible on board. Through parallel efforts, the Center proposes to determine the limits of performance for specific material systems and extract general mechanistic information that can be used for further design and optimization. A key effort is to determine the relationship between nanoscale structure and the energetics of hydrogen binding using a variety of experimental and theoretical tools and well-defined nanostructured materials. Materials of interest include single-walled carbon nanotubes, graphite nanofibers, multi-walled nanotubes, alkali metal intercalated carbons and nanotubes, carbon nanohorns, chemomechanically processed (ball-milled) materials, metal catalyst decorated and substitutionally doped versions of these, conducting polymers, and metal-organic frameworks.

The Center will ultimately select and demonstrate a prototype hydrogen storage system that has the potential to meet DOE’s hydrogen storage performance goals.

#### **Objectives for Category 1:**

Category 1 projects will be funded for a 2 to 5 year period consisting of two phases with a project go/no-go decision point at the end of the first phase.

Phase 1 is intended to explore new concepts, to develop novel materials, and to investigate material properties and hydrogen storage performance. The primary Phase 1 objectives are to assess the feasibility of new hydrogen storage materials and concepts and to determine their

potential to meet the 2010 performance targets. Concepts and materials with potential to meet the 2015 performance targets may also be explored. Results should be reproducible, and technical data reported to DOE should include, but are not limited to, data on capacity, kinetics, and thermodynamics.

Phase 2 is intended to address further material development and to improve, optimize, and demonstrate material performance and properties. The primary Phase 2 objectives are to demonstrate that the material or concept meets the 2010 performance targets, and to show potential toward meeting the 2015 performance targets. Results should be reproducible, and technical data reported to DOE should include, but are not limited to, data on capacity, kinetics, thermodynamics, cycle life, and other material properties. An additional objective for Phase 2 is to provide input to DOE relevant to the design and construction of a system prototype.

Material samples resulting from the R&D effort will be submitted for independent, standardized testing at a facility to be specified by DOE.

#### **Cost share requirements for Category 1:**

Only National Laboratories, as defined by Section 2 of the Energy Policy Act of 2005, may apply as the primary applicant under this announcement. No cost sharing is required for the National Laboratory portion of the project. If the National Laboratory has a non-National Lab partner, then a minimum of 20% cost share for that portion of the project must be provided from non-Federal sources. Other federal laboratories who team, as a subcontractor, with a National Laboratory primary applicant are not required to cost share their portion of the project.

#### **Category 2:**

Category 2 projects are independent projects (i.e. not associated with a DOE Center) that propose a new hydrogen storage material and/or concept and seek to establish the feasibility of the proposed new approach **in one of three technical topic areas summarized below**. Such projects will typically be high risk, “outside the box” concepts but with technical credibility and potential for high pay-off. Also solicited are novel reactor design/engineering concepts, novel approaches to thermal management in hydrogen storage systems, methods for combinatorial or high throughput screening for rapidly identifying high storage capacity materials, and systems, storage material safety, and environmental analyses.

Applications are sought for independent research and development projects addressing one of the following three technical topics. The appropriate **category and** topic must be clearly stated on the cover page of the application. Applicants may not submit an application that covers more than one topic, i.e. separate applications must be submitted for separate topics. Research and development of cylindrical high pressure or liquid on-board storage tanks and off-board storage are not sought under this announcement and will not be reviewed.

#### **Topic 1: Materials Discovery**

Research and development areas sought under Topic 1 include, but are not limited to, new materials and concepts in the following areas: advanced metal hydrides, chemical hydrogen storage materials, carbon-based materials, high surface area adsorbents, and completely novel

approaches. For chemical hydrogen storage materials, off-board regeneration must be considered. Improvements to the hydrogen storage gravimetric and volumetric capacity of new materials as well as hydrogen uptake and discharge kinetics, energy efficiency, operating temperature and pressure, cycle life, cost and durability of materials upon exposure to contaminants are appropriate. Novel materials or chemistry for off-board regeneration of chemical hydrogen storage carriers are solicited. Development and application of new processes (such as mechanochemistry, sonochemistry, irradiation, etc.) that can aid in the development of unique material properties (nanostructures, low cost manufacturing, etc.) are also applicable under this topic. Topic 1 would also include approaches for high throughput/combinatorial synthesis, screening and testing of storage materials and other novel characterization techniques that can aid in and be applied to the discovery of new materials.

**Objectives for Topic 1:**

Topic 1 projects will be funded for a 2 to 5 year period consisting of two phases with a project go/no-go decision point at the end of the first phase.

Phase 1 is intended to explore new concepts, to develop novel materials, and to investigate material properties and hydrogen storage performance. The primary Phase 1 objectives are to assess the feasibility of new hydrogen storage materials and concepts and to determine their potential to meet the 2010 performance targets. Concepts and materials that show potential to meet the 2015 performance targets may also be explored. Results should be reproducible, and technical data reported to DOE should include, but are not limited to, data on capacity, kinetics, and thermodynamics.

Phase 2 is intended to address further material development and to improve, optimize, and demonstrate material performance and properties. The primary Phase 2 objectives are to demonstrate that the material or concept meets the 2010 performance targets and to show potential toward meeting the 2015 performance targets. Results should be reproducible, and technical data reported to DOE should include, but are not limited to, data on capacity, kinetics, thermodynamics, cycle life, and other material properties. An additional objective for Phase 2 is to provide input to DOE relevant to the design and construction of a system prototype.

Material samples resulting from the R&D effort will be submitted for independent, standardized testing at a facility to be specified by DOE.

**Cost share requirements for Topic 1:**

Only National Laboratories, as defined by Section 2 of the Energy Policy Act of 2005, may apply as the primary applicant under this announcement. No cost sharing is required for the National Laboratory portion of the project. If the National Laboratory has a non-National Lab partner, then a minimum of 20% cost share for that portion of the project must be provided from non-Federal sources. Other federal laboratories who team, as a subcontractor, with a National Laboratory primary applicant are not required to cost share their portion of the project.

**Topic 2: Engineering Science**

Research and development areas sought under Topic 2 include, but are not limited to, novel reactor design, engineering concepts, and viable approaches to thermal management. Rather than standard reactor design engineering, this topic is for completely new concepts that have the potential to significantly reduce the weight and volume of storage systems while meeting all

safety, cost and performance requirements, including thermal management during hydrogen refueling and release. Novel reactor design, engineering concepts and processes for off-board regeneration of chemical hydrogen storage materials are applicable under this topic. Applicable hydrogen storage materials include, but are not limited to, metal hydrides, chemical hydrogen storage materials, carbon-based materials, high surface area adsorbents, and hybrid materials. While the focus is on materials-based technologies that operate at low pressure (less than ~ 150 atm), novel approaches to low cost conformable containers for moderate to high pressure systems (e.g. up to 700 atm) would also be applicable.

In addition, proposals related to the testing and characterization of material safety properties would be applicable under Topic 2. Development of an understanding of environmental and chemical reactivity of materials and the stability of materials upon exposure to various conditions and contaminants is also applicable. Development and application of standard testing techniques to quantitatively evaluate both materials and systems in terms of safety / environmental impact characteristics and exposure to a variety of operating and handling conditions (such as exposure to air, humidity, etc.) are also applicable under Topic 2.

**Objectives for Topic 2:**

Topic 2 projects will be funded for a 2 to 5 year period consisting of two phases with a project go/no-go decision point at the end of the first phase.

Phase 1 is intended to investigate novel engineering concepts for hydrogen storage systems and to develop a greater understanding of engineering science related issues and/or material safety/environmental impact properties. The Phase 1 objective is to assess the feasibility of novel engineering concepts to determine their potential to enable hydrogen storage systems to meet the 2010 performance targets. Concepts that show potential to enable meeting the 2015 performance targets may also be explored. Novel engineering concepts may include novel components, novel approaches to thermal management, conceptual engineering designs, safety investigations, or environmental impact investigations. Results to be reported to DOE should include the results of feasibility studies, conceptual designs with projected performance characteristics in comparison to the DOE targets, or the results of safety or environmental impact investigations as appropriate for the individual project.

Phase 2 is intended to expand the conceptual designs and/or feasibility studies from Phase 1 to include additional simulation, bench-scale experimental testing if applicable, and estimates of weight, volume and cost. The primary Phase 2 objectives are to demonstrate that the novel engineering concept will enable hydrogen storage systems to meet the 2010 performance targets and to show potential to meet the 2015 performance targets. Results to be reported to DOE should include design and simulation results with performance characteristics in comparison to the DOE targets, bench-scale testing results, or the results of safety or environmental impact investigations as appropriate for the individual project. Estimates of weight, volume, cost, and other performance characteristics (such as thermal management required during charging and discharging) should also be reported to DOE.

Topic 2 projects may include bench-scale component testing as required to assess the feasibility of a novel concept. However, Topic 2 projects are not intended to include construction or testing of complete prototype hydrogen storage systems.

**Cost share requirements for Topic 2:**

Only National Laboratories, as defined by Section 2 of the Energy Policy Act of 2005, may apply as the primary applicant under this announcement. No cost sharing is required for the National Laboratory portion of the project. If the National Laboratory has a non-National Lab partner, then a minimum of 20% cost share for that portion of the project must be provided from non-Federal sources. Other federal laboratories who team, as a subcontractor, with a National Laboratory primary applicant are not required to cost share their portion of the project.

**Topic 3: Systems, Safety and Environmental Analyses**

Applications are sought under Topic 3 for technical feasibility, environmental and economic analyses that compare and contrast various emerging on-board hydrogen storage technologies.

Applications focusing on safety analyses of competing technologies are also sought under Topic 3. Examples include cradle-to-grave or life cycle analyses, including but not limited to, energy efficiency, environmental impact, life cycle cost and emissions analyses. Topic 3 is for analyses only and does not include laboratory work.

**Objective for Topic 3:**

The primary objective of Topic 3 is to investigate and document life-cycle cost, energy efficiency, environmental impact, and safety of different on-board storage options. Analyses should include the effects of cost and performance trade-offs. Results to be reported to DOE should include systems analyses of energy efficiency, life-cycle costs, emissions, safety, and environmental impacts of various on-board storage options. Rather than focusing on one specific material, the intent of this topic is to provide analyses for classes of materials or chemistries across various options for on-board hydrogen storage.

**Cost share requirements for Topic 3:**

No cost sharing is required for projects under Topic 3.